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ABSTRACT

A review of the current status of data processing (DP) in management information systems, including the functions assigned to DP in organizations, what it was designed to do, and levels of training of personnel, provides the basis for an examination of new demands on DP. An approach which is advocated as a means of overcoming many of the deficiencies of current practices is based on general systems theory, organizational development theory, and problem solving. (RAO)

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WHY SYSTEMS FAIL

By William Bearley

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Computers have been in wide use for just over twenty years. These machines have been applied to a variety of functions within organizations. During this same period there has been an extraordinary increase in computing capabilities with significant decreases in hardware cost. This has led to wider use and increased expectations on the part of management.

However, in recent years this excitement and anticipation has turned to frustration and disappointment. The oversell of the future of management information systems in the 1960's has caused management to question the expense and relevance of DP.

In the last several years there have been significant increases in the cost of DP personnel with a decline in programming productivity. Programmers are now spending a large portion of their time doing maintenance, leaving less time for new applications. New systems are becoming more complex, are often outdated when delivered and do not meet the needs of the users. Management is constantly complaining that DP is not meeting their needs and they are beginning to question the expense. In general, DP installations are becoming bogged down and are not able to keep up with change or satisfy new requests for services.

This paper will review how DP was conceived in most organizations, what it was designed to do, and the level of training of the people. Using this basis, new demands on DP will be examined. Finally, a different approach will be explored which overcomes many of the current deficiencies. However, before describing DP directly, it is necessary to define some terms and establish a conceptual base for discussion.

Systems Theory

Johnson, Kast and Rosenzweig define a system as "an organized or complex whole; an assemblage or combination of things or parts forming a complex or unitary whole." Ackoff indicates that it is a "set of interrelated elements." Key to these definitions are the concepts of wholeness, elements or subsystems within a system, and the interaction or interrelationship among and between the elements and the whole. General Systems Theory is concerned with developing a theoretical framework for describing systems including classifications and laws of behavior for different types of systems.

An important aspect within general systems theory is the distinction between open and closed systems. A closed system is a determinate system which does not interact with its environment. Closed systems are predictable with fixed variables and interrelationships which we can comprehend since they are not affected by outside forces. Open systems are influenced by and in turn influence their environment. They often consist of more variables and interrelationships than we can comprehend and are subject to influences over which we have no control and cannot predict.

Organizations

Organizations are man-made systems which organize men and resources into an effective and efficient enterprise. An organization is an open system consisting of a number of interrelated and interacting subsystems. It can be considered as a sociotechnical system which is in constant interaction with its environmental suprasystem. As such, organizations contain more variables and interrelationships than we can comprehend or control and are constantly interacting with their environment which we cannot predict or control.

Most organizations are hierarchical in nature. Anthony defines the three primary levels of strategic planning (strategic), management control (coordinative) and operational control (operative) as shown in Figure 1. Operational control is the process of assuring that specific tasks are carried out effectively and efficiently. This subsystem focuses on tasks or transactions. This level is responsible for accomplishing the stated objectives of delivering the product or service of the system such as producing automobiles or teaching students. To eliminate uncertainty at this level and to be able to control the variables as much as possible the operative subsystem is relatively closed. Processes can be programmed and outcomes are predictable.

Figure 1

Management control is the process by which managers assure that resources are obtained and used effectively and efficiently in the accomplishment of the organization's goals. This coordinative sub-

system is primarily concerned with integrating internal activities which are usually specialized by functions. Managers at this level translate comprehensive plans into operational plans and procedures then evaluate the results. They must also assure that the necessary resources are available in a timely manner.

Strategic planning is the process of deciding on the goals of organization, on changes in these goals, on the resources used to attain these goals, and on the policies that are to govern the acquisition, use and disposition of these resources. Anthony uses the word strategy in the sense of deciding on how to combine and employ resources. This level is responsible for the formulation of long-term, strategic, policy-type plans which change the character or direction of the organization. The strategic subsystem is the most affected by the environment. Its nature is irregular and unprogrammable with events being dealt with whenever they are perceived.

Parsons likewise recognizes three distinct levels of responsibility within organizations - technical, managerial, and institutional. Figure 2 depicts these levels along with the environmental suprasystem.

The technical subsystem level is oriented to the nature of the technical task of the total system such as the materials which must be produced, the services which must be delivered and the kinds of cooperation of different people required to get the job done effectively.

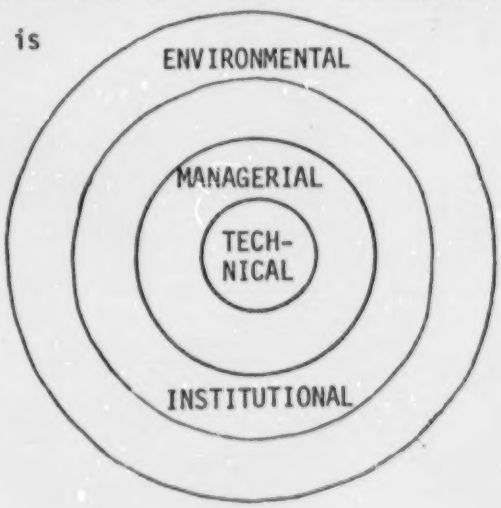

Figure 2

The managerial subsystem services the technical subsystem by mediating between the technical level and those who use its products - pupils, customers, etc. - and procuring the resources necessary for carrying out the technical functions. This level administers and controls the technical subsystem.

The institutional subsystem is responsible for making the implementation of the organization goals possible. This level articulates the organization with the institutional structure and agencies of the environment.

Parsons points out that at each of the two points between the levels there is a qualitative break in the line of authority because the functions at each level are qualitatively different, that is technical functions are not simple lower-order managerial functions but are quite different. Articulation between the levels is more difficult within a level and is dependent on two-way interaction. Figure 3 which is in part derived from Kast and Rosenzweig summarizes some of the significant differences between the levels of an organization.

DP in Organizations

Traditionally, data processing is initiated within organizations at the operational level to solve operational problems. It is itself usually an operational department with a functional manager at the second level responsible for its activities in the organization. Since DP has an operational focus it is structured to deal primarily with operational requirements. Following is a list of a few of the limitations imposed on DP due to this operational orientation:

1. DP approaches new requirements from an individual application

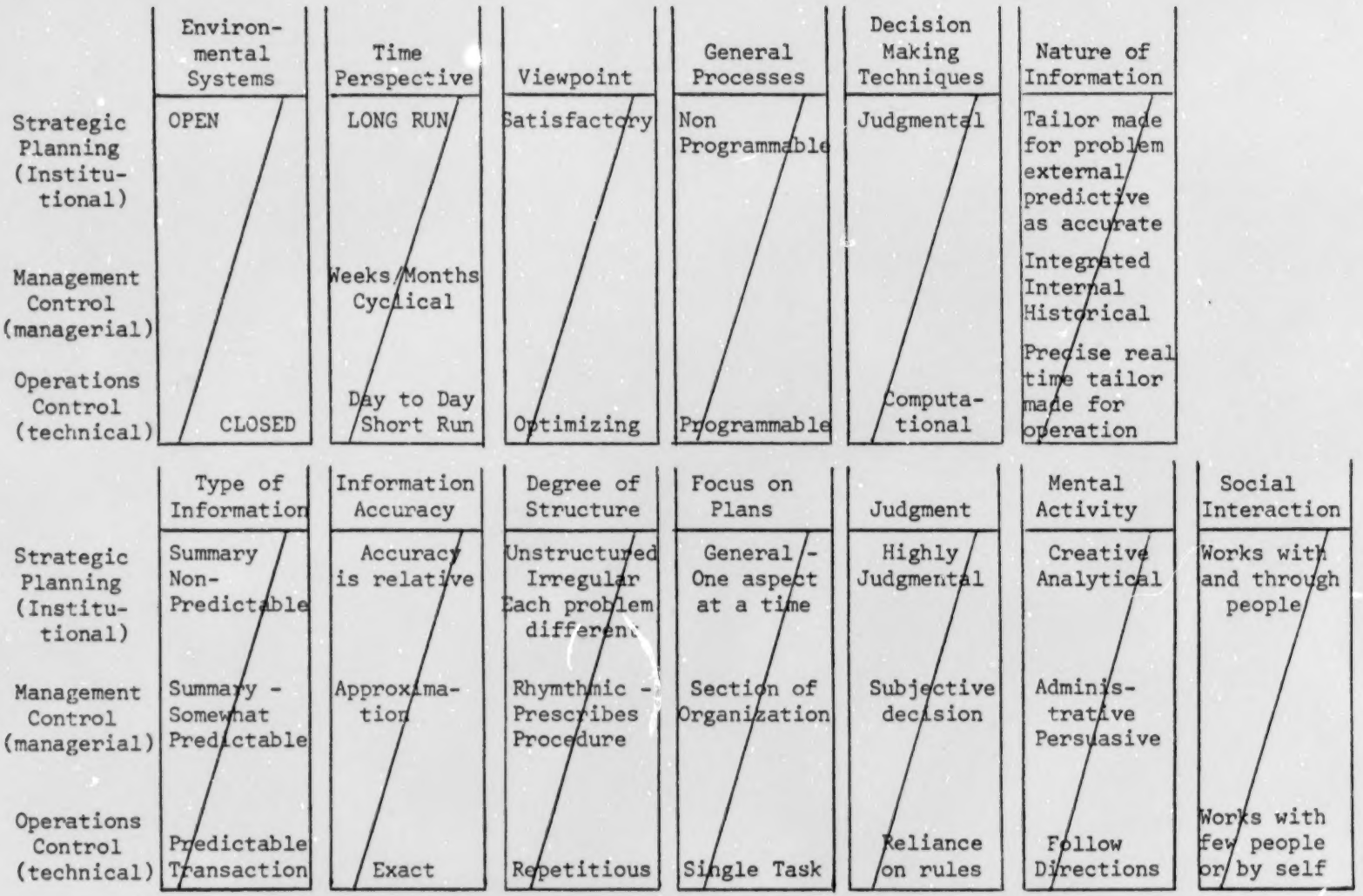
Environmental Systems
Time Perspective
Viewpoint
General Processes
Decision Making Techniques
Nature of Information
Strategic Planning (Institutional)
Management Control (managerial)
Operations Control (technical)
OPEN
CLOSED
LONG RUN
Weeks/Months Cyclical
Day to Day Short Run
Satisfactory
Optimizing
Non Programmable
Programmable
Judgmental
Computational
Tailor made for problem external predictive as accurate
Integrated Internal Historical
Precise real time tailor made for operation
Type of Information
Information Accuracy
Degree of Structure
Focus on Plans
Judgment
Mental Activity
Social Interaction
Summary Non-Predictable
Summary - Somewhat Predictable
Predictable Transaction
Accuracy is relative
Approximation
Exact
Unstructured Irregular Each problem different
Rhymthmic - Prescribes Procedure
Repetitious
General - One aspect at a time
Section of Organization
Single Task
Highly Judgmental
Subjective decision
Reliance on rules
Creative Analytical
Administrative Persuasive
Follow Directions
Works with and through people
Works with few people or by self

Figure 3

focus rather than with an overall organizational or system viewpoint

2. Systems are implemented on an application by application basis rather than a system-wide approach

3. Typical systems analysis techniques approach the design of systems on an operational applications level

4. Common computer languages are conceptualized at the application level, not at a functional level. This requires each program to be considered individually

5. Training for analysts and programmers is based on individual applications not on an organizational approach

6. Design of systems in organizations usually start at the bottom. It then becomes difficult to cross the line to the next level

7. Design and programming concepts and techniques currently in use function best in a controlled closed system environment. They begin to break down when there is a great deal of change or unpredictability

8. Having been conceived at the operational level, DP has no concept of the differences between the levels of an organization or the requirements at each level

9. DP is not trained in the interpersonal skills required in the social relationships required in management

Since DP was conceived at the operational level it functions best in relatively closed, predictable situations where there is no interference from the environment. Added to this are the current time and resources required for the gestation of a new application coupled with the reality that traditional programs are fixed and inflexible, both of which require the stability and predictability of a closed system. The entire language of systems analysis and programming force applications to be closed with the final product fixed in machine code. The cost of changing such systems becomes quite high causing DP to be inflexible and unable to cope with change. This would indicate several conditions which must be met for DP to

function:

1. There must be minimal change in the operational level requirements which cause modification to many individual applications. In other words, the system must be relatively closed so the variables and requirements are constant

2. There can be no sudden demand at the operational level or any other level for new requirements. Since each application is developed independently, there is a limit to the number of new projects a DP staff can cope with at one time. Since the approach used is also sequential, putting more people on the task often only confuses the issue and will not speed up the process

3. There must be continuity within the department itself. Any significant internal changes such as new hardware will require a massive conversion of all the individual applications

4. There can be no demands by the upper two levels of the organization for information which requires integration across several or all application areas. Further complications are caused by the irregularity and uncertainty which is introduced as demands come from higher in the organization

When DP is first brought into an organization it is to solve one or more operational level problems. As time goes on, more and more applications are created. This builds up a large volume of applications which, when changes do occur, causes disruption to DP and to the organizaton as a whole. As time goes on, upper management begin to expect some useful results for their use. This means DP now has to deal with new types of problems for which they are neither organized nor prepared. The result is frustration and disruption within the organization.

The scenario above has been complicated by substantial increases in computing technology, decreases in hardware cost and expanded horizons of the problem solvers. Top management has therefore become acutely aware of the escalating people cost in DP, decline in DP service, frustration of users and what seems to be a failure to address

the information needs of management. Actually, management problems are different than those DP is currently capable of handling since DP is oriented toward operational applications and not toward providing information for management decision making.

While there are many ways to approach this dilemma, two general alternatives seem immediately obvious.

1. Let DP function at the operational level only and don't expect it to perform tasks which are outside its current capabilities. This also indicates that the environment needs to be more closed so the number of variables is limited, controlled and predictable. By realizing the limitations and lowering expectations, users of DP services will be less frustrated and there will be less pressure on DP to perform tasks for which they are not prepared

2. Establish a new philosophy of information resources management which integrates information from the top down rather than the bottom up. This will ultimately lead to an integrated system which will be flexible to change and will meet the information needs at all levels of the organization. Policies, structures, strategies, software and training can then be developed that is oriented to the management of the information resource and problem solving, not to specific operational applications.

Any organization choosing the second alternative must be committed to a significant change effort. This must start from the top and must pervade the entire organization. This will require new policies, structures, and processes for management of the information resources of an organization. There must also be a massive training program for managers, users and especially DP technicians because past methods and solutions will not work in this new environment.

Data as a Valuable Resource

In order to establish the need for organizational-wide management of the information resource it is important to understand why data and information is a valuable resource. Blumenthal indicates that information is data recorded, classified, organized, related or

interpreted within context to convey meaning. Datum is then an unrelated raw statement of fact which has no value until it is used in some way. Figure 4 depicts the flow from data to information to decision making. This cycle is time dependent indicating that the information is only relevant at the time it is needed to solve a problem. It also indicates that data will change based on the effects and consequences of the decision.

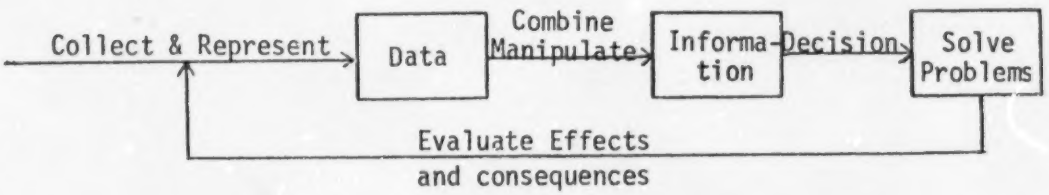

Figure 4

Thayer points out that in human communication systems information is what people do to data. It is information, not data, that is the raw material for thinking, problem solving and improving or making decisions.

Since decisions are the driving forces of organizations data and information become valuable resources to an organization. Zackman says that data derives its value from its requirement to support the management planning and control systems. Since information is the key to good decision making it must also be delivered to the decision maker in a timely manner. IBM concludes that as a commodity, information has two characteristics which can give it true monetary value - relevance and timeliness - and if either is missing the information is useless. Data if not used is raw data and has little value.

11.

If information is to be considered as a valuable resource then like any other resource it must be properly managed if its value is to be preserved. It is therefore important for an organization to establish organization-wide policies, structures and procedures to manage these resources. Information resource management then becomes the function of an organization responsible for managing this resource. Data processing becomes a part of this function but is not the total system. As Anthony indicates this includes all activities having to do with the systematic flow of information within an organization. Figure 5 depicts Anthony's view of information systems in organizations which he perceives as serving all levels not just the operative subsystem.

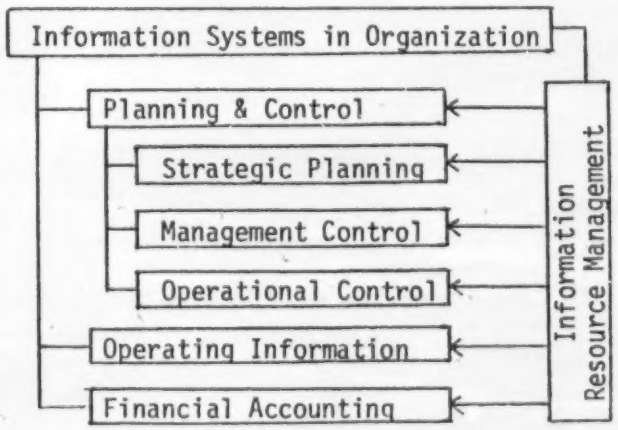

Figure 5

If an organization is to establish an organization-wide information resource management system, it must institutionalize new policies, strategies and procedures for this purpose. There must be a commitment to establish a firm foundation on which the system can be built. Fundamental to this is the recognition at a policy level that

data is a valuable resource. The conceptualization of the system must then be done on a top down basis so that all levels of the organization are included. There must be vertical, horizontal and longitudinal integration throughout the organization.

The function of information resources management must be established. This must be at the top level of the organization under a manager that has organization-wide responsibility. DP then becomes a service within this function and will become one of many tools used.

General criteria must be established for this function and must include measures of efficiency, effectiveness, adaptability, controllability and accountability. Adaptability is of prime importance to prevent the traditional traps of DP.

Another key to the success of this system is the philosophy that the user, not DP, is responsible for the data. This includes collection, input, validation, maintenance and use of data. This not only requires that the system meet the user's needs in the user's environment but that the user is held accountable for carrying out their responsibility.

It is important to warn the reader that the traditional approaches used to analyze, design and implement will not work. New methods must be developed based on general systems theory, organizational theory, organizational development theory, and problem solving. If this is not done any new approach is doomed to failure from the beginning.

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